

- 17 -

WHAT IS CLAIMED IS:

1. A method of providing multiple simultaneous services through a single broadband connection to an end user, said end user being connected to a core network through first and second independently tagged Virtual Local Area Network (VLAN) regions, said method comprising the steps of:

implementing a VLAN Mapping Point at a border between the first and second VLAN regions, wherein the first VLAN region is on a first side of the VLAN Mapping Point toward the end user, and the second VLAN region is on a second side of the VLAN Mapping Point toward the core network;

receiving in the VLAN Mapping Point, an upstream traffic packet from the first VLAN region;

upon receiving the upstream packet:

mapping in the VLAN Mapping Point, a VLAN tag for the first VLAN region to a VLAN tag for the second VLAN region; and

forwarding the upstream traffic packet to the core network using the VLAN tag for the second VLAN region;

receiving in the VLAN Mapping Point, a downstream traffic packet from the second VLAN region;

upon receiving the downstream packet:

mapping in the VLAN Mapping Point, a VLAN tag for the second VLAN region to a VLAN tag for the first VLAN region; and

forwarding the traffic to the end user using the VLAN tag for the first VLAN region.

30

- 18 -

2. The method of claim 1, wherein the step of mapping a VLAN tag for the first VLAN region to a VLAN tag for the second VLAN region includes the steps of:
obtaining the VLAN tag for the second VLAN region from a
5 table in the VLAN Mapping Point; and
replacing a VLAN ID in the upstream traffic packet with the VLAN tag for the second VLAN region.
3. The method of claim 2, wherein the step of mapping a
10 VLAN tag for the second VLAN region to a VLAN tag for the first VLAN region includes the steps of:
obtaining the VLAN tag for the first VLAN region from a table in the VLAN Mapping Point; and
replacing a VLAN ID in the downstream traffic packet with
15 the VLAN tag for the first VLAN region.
4. The method of claim 3, wherein the step of obtaining the VLAN tag for the first VLAN region from a table in the VLAN Mapping Point includes the steps of:
20 determining whether the downstream traffic packet is a unicast packet or a multicast packet;
upon determining that the downstream traffic packet is a unicast packet, extracting a destination Media Access Control (MAC) address from the unicast downstream packet;
25 and
obtaining the VLAN tag for the first VLAN region from the table by matching the extracted MAC address to a corresponding VLAN tag for the first VLAN region.
5. The method of claim 3, wherein the step of obtaining the VLAN tag for the first VLAN region from a table in the VLAN Mapping Point includes the steps of:

- 19 -

determining whether the downstream traffic packet is a unicast packet or a multicast packet;

upon determining that the downstream traffic packet is a unicast packet, extracting from the unicast downstream packet, a destination Media Access Control (MAC) address and the VLAN tag for the second VLAN region; and

obtaining the VLAN tag for the first VLAN region from the table by matching the extracted MAC address and the VLAN tag for the second VLAN region to a corresponding VLAN tag for the first VLAN region.

6. The method of claim 4, wherein the step of obtaining the VLAN tag for the first VLAN region from a table in the VLAN Mapping Point also includes the step of:
upon determining that the downstream traffic packet is a multicast packet, obtaining from the table, a common VLAN tag for all end users in the first VLAN region.

7. The method of claim 4, wherein the step of obtaining the VLAN tag for the first VLAN region from a table in the VLAN Mapping Point also includes the steps of:
upon determining that the downstream traffic packet is a multicast packet, extracting an aggregate VLAN tag from the multicast downstream packet;
determining a number of entries in the table for which VLAN tags for the first VLAN region are associated with the extracted aggregate VLAN tag; and
duplicating the downstream traffic packet for each of the entries in the table for which a VLAN tag for the first VLAN region is associated with the extracted aggregate VLAN tag;

- 20 -

wherein the VLAN Mapping Point changes the VLAN ID in each of the duplicated downstream traffic packets to include a different one of the associated VLAN tags for the first VLAN region, and forwards the duplicated downstream traffic packets to end users using the associated VLAN tags for the first VLAN region.

8. The method of claim 1, wherein the first VLAN region is a last-mile network connecting the end user to the VLAN Mapping Point, and the second VLAN region is an aggregation network connecting a Layer 2 termination point to the VLAN Mapping Point.

9. The method of claim 8, wherein the VLAN tag for the first VLAN region is a VLAN-per-user-per-service tag, and the VLAN tag for the second VLAN region is a VLAN-per-service tag.

10. A Virtual Local Area Network (VLAN) Mapping Point implemented at a border between first and second independently tagged VLAN regions, wherein the first VLAN region is on a first side of the VLAN Mapping Point toward an end user, and the second VLAN region is on a second side of the VLAN Mapping Point toward a core network, said VLAN Mapping Point comprising:

a first interface for receiving upstream traffic packets from the first VLAN region, and for sending downstream traffic packets to the first VLAN region;

a second interface for receiving downstream traffic packets from the second VLAN region, and for sending upstream traffic packets to the second VLAN region; and

- 21 -

a mapping function connected to the first and second interfaces that, upon receiving from the first interface an upstream traffic packet that includes a VLAN tag for the first VLAN region, maps the VLAN tag for the first VLAN region to a VLAN tag for the second VLAN region, and sends the mapped upstream traffic packet to the second interface, and, upon receiving from the second interface a downstream traffic packet that includes a VLAN tag for the second VLAN region, maps the VLAN tag for the second VLAN region to a VLAN tag for the first VLAN region, and sends the mapped upstream traffic packet to the second interface.

11. The VLAN Mapping Point of claim 10, wherein the mapping function includes:
a mapping table that matches VLAN tags for the first VLAN region to associated VLAN tags for the second VLAN region; and
means for changing a VLAN ID in received traffic packets, said means for changing a VLAN ID replacing the VLAN ID in upstream traffic packets with the VLAN tag for the second VLAN region.

12. The VLAN Mapping Point of claim 11, wherein the mapping table also matches VLAN tags for the second VLAN region to associated VLAN tags for the first VLAN region, and the means for changing a VLAN ID in a received traffic packet also replaces the VLAN ID of downstream traffic packets with the VLAN tag for the first VLAN region.

13. The VLAN Mapping Point of claim 12, wherein the mapping function also includes:

- 22 -

means for determining whether a received downstream traffic packet is a unicast packet or a multicast packet;

means, responsive to determining that the downstream traffic packet is a unicast packet, for extracting a
5 destination Media Access Control (MAC) address from the unicast downstream packet; and

means for obtaining the VLAN tag for the first VLAN region from the mapping table by matching the extracted MAC address to a corresponding VLAN tag for the first VLAN
10 region.

14. The VLAN Mapping Point of claim 13, wherein the mapping function also includes:

means, responsive to determining that the downstream
15 traffic packet is a multicast packet, for obtaining from the mapping table, a common VLAN tag for all end users in the first VLAN region.

15. The VLAN Mapping Point of claim 13, wherein the
20 mapping function also includes:

means responsive to determining that the downstream traffic packet is a multicast packet, for extracting an aggregate VLAN tag from the multicast downstream packet;

means for determining a number of entries in the table for
25 which VLAN tags for the first VLAN region are associated with the extracted aggregate VLAN tag; and

means for duplicating the downstream traffic packet for each of the entries in the table for which a VLAN tag for the first VLAN region is associated with the extracted
30 aggregate VLAN tag;

wherein the VLAN Mapping Point replaces the VLAN ID in each of the duplicated downstream traffic packets with a

different one of the associated VLAN tags for the first VLAN region, and forwards the duplicated downstream traffic packets to end users using the associated VLAN tags for the first VLAN region.

5

16. The VLAN Mapping Point of claim 10, wherein the first VLAN region is a last-mile network connecting the end user to the VLAN Mapping Point, and the second VLAN region is an aggregation network connecting a Layer 2 termination point to the VLAN Mapping Point.

17. The VLAN Mapping Point of claim 16, wherein the VLAN tag for the first VLAN region is a VLAN-per-user-per-service tag, and the VLAN tag for the second VLAN region is a VLAN-per-service tag.

18. A method of mapping Ethernet traffic packets between first and second independently tagged Virtual Local Area Network (VLAN) regions, said method comprising the steps of:

implementing a VLAN Mapping Point at a border between the first and second VLAN regions, said VLAN Mapping Point including a mapping function that associates VLAN tags for each of the VLAN regions with VLAN tags for the other VLAN region;

receiving in the VLAN Mapping Point, a traffic packet from the first VLAN region, said traffic packet from the first VLAN region including a VLAN tag for the first VLAN region;

- 24 -

upon receiving the traffic packet from the first VLAN region:

mapping in the VLAN Mapping Point, the VLAN tag for the first VLAN region to an associated VLAN tag for the second VLAN region; and

forwarding the traffic packet to the second VLAN region using the VLAN tag for the second VLAN region;

receiving in the VLAN Mapping Point, a traffic packet from the second VLAN region, said traffic packet from the second VLAN region including a VLAN tag for the second VLAN region; and

upon receiving the traffic packet from the second VLAN region:

mapping in the VLAN Mapping Point, the VLAN tag for the second VLAN region to a VLAN tag for the first VLAN region; and

forwarding the traffic to the first VLAN region using the VLAN tag for the first VLAN region.

19. The method of claim 18, wherein the first VLAN region is a last-mile network connecting the end user to the VLAN Mapping Point, and the second VLAN region is an aggregation network connecting a Layer 2 termination point to the VLAN Mapping Point.

25

20. The method of claim 19, wherein the VLAN tag for the first VLAN region is a VLAN-per-user-per-service tag, and the VLAN tag for the second VLAN region is a VLAN-per-service tag.

30

21. A method of providing multiple simultaneous services through a single broadband connection to an end

- 25 -

user, said end user being connected to a core network through first and second independently tagged Virtual Local Area Network (VLAN) regions, said method comprising the steps of:

- 5 implementing an access node at a border between the first and second VLAN regions, wherein the first VLAN region is on a first side of the access node toward the end user, and the second VLAN region is on a second side of the access node toward the core network;
- 10 separating, in the second VLAN region, traffic from multiple end users, by implementing an Address Resolution Protocol (ARP) proxy function in the access node that ensures that upstream traffic packets from the first VLAN region are always sent to a designated access router;
- 15 mapping by the access node, VLAN tags received in upstream traffic packets to VLAN tags for the second VLAN region; and
- 20 mapping by the access node, VLAN tags in downstream traffic packets received from the second VLAN region to VLAN tags for the first VLAN region.

22. The method of claim 21, wherein the VLAN tags for the first VLAN region are VLAN-per-user-per-service tags, and the VLAN tags for the second VLAN region are VLAN-per-service tags.

25